



## CLINICAL REVIEW

## Sleep tight: Exploring the relationship between sleep and attachment style across the life span

G. Camelia Adams<sup>a,\*</sup>, Melissa A. Stoops<sup>a</sup>, Robert P. Skomro<sup>b</sup><sup>a</sup> Department of Psychiatry, University of Saskatchewan, Saskatoon, Canada<sup>b</sup> Division of Respiriology, Critical Care and Sleep Medicine, Department of Medicine, University of Saskatchewan, Saskatoon, Canada

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## SUMMARY

Based on early life experiences in which developmental, genetic, and environmental components interact, humans learn to trust themselves and others and connect emotionally in consistent ways that are broadly defined as “attachment styles.” These relatively stable patterns of interpersonal interaction are associated with either vulnerability to various health risks or resilience. Similarly, the mechanisms involved in sleep regulation undergo developmental changes that overlap temporally with attachment formation and remain sensitive to a series of biological, environmental and psychological influences. Interestingly, while sleep has been conceptualized as a fundamental attachment behavior given its dyadic context, few studies have explored its relationship with attachment style in various ages. We present the first systematic review of the published literature examining the relationship between attachment style and sleep in humans across the life span. While levels of evidence and methods of assessment vary significantly, the results suggest a possible life-long relationship between individual attachment style and sleep. These findings are particularly useful in understanding relatively ingrained psychological mechanisms that can affect and be affected by sleep. Clinical and research implications are discussed.

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## Introduction

Over the last decade, attachment theory has become an increasingly important paradigm for understanding various aspects of health. Psychosomatic research has shown that attachment style can influence health behaviors, such as treatment utilization and adherence, the ability to cope with stress and illness, and ultimately represents a form of resilience that plays a significant role in morbidity and mortality [1–8]. A myriad of studies have shown that attachment insecurity is a vulnerability that can predispose individuals to a wide range of psychological disorders, including mood and anxiety disorders, substance use disorders, personality disorders, and psychosis [9]. Despite the extensive literature

investigating the role of attachment style in various conditions pertaining to mental and physical health, very little attention has targeted its relationship to sleep. This lack of attention is surprising given the high prevalence of sleep difficulties and the contribution of sleep to mental health, morbidity and mortality. Sleep disorders are recognized as very common complaints, with more than 40% of the general population reporting at least one symptom of disturbed sleep [10]. Similarly, more than one third of working individuals in the United States experience disrupted sleep at a level which affects work performance and absenteeism [11]. Sleep difficulties are often accompanied by depression, anxiety and cognitive changes and their persistence is an established risk factor for subsequent mental illness and substance use disorders [12–14]. Difficulty falling or staying asleep and vivid or disturbing dreams are examples of the many sleep complaints reported by psychiatric patients. Still, very few studies have investigated the relationship between attachment styles and sleep disorders in the general population, and fewer still have done so in clinical psychiatric populations. In a very informative narrative review, Keller [15] has reviewed some of the published work, summarizing four adult studies and seven studies in children. Expanding on Keller's work, we are offering the first systematic review of the published literature on the relationship

*Abbreviations:* AAI, adult attachment interview; ECR, experiences in close relationships; ECR-R, revised experiences in close relationships; NREM, non-rapid eye movement; PSG, polysomnography; PSQI, Pittsburgh sleep quality index; REM, rapid eye movement; SSP, strange situation procedure.

\* Corresponding author. Department of Psychiatry, Ellis Hall, Royal University Hospital, 103 Hospital Drive, Saskatoon, Saskatchewan S7N 0W8, Canada. Tel.: +1 306 844 1078; fax: +1 306 844 1504.

E-mail address: [gcg417@mail.usask.ca](mailto:gcg417@mail.usask.ca) (G.C. Adams).

between attachment style and sleep in humans across the life span. In contrast to Keller's work [15], our review also includes a brief review of studies on dreams and attachment [16,17]. We begin our review by discussing key concepts regarding attachment theory and sleep, including their progression throughout life. Next, we summarize and evaluate existing human studies investigating the relationship between attachment styles and sleep in all ages. Keeping in mind the conceptual and methodological limitations of the published literature, we review and discuss a few possible theoretical interpretations, while comparing and contrasting with the findings from animal studies. We conclude by suggesting research directions that might advance our understanding of this intricate and multidisciplinary field.

### Attachment style: theoretical models and measures

Based on the joint work of John Bowlby (1907–1991) and Mary Ainsworth (1913–1999), attachment theory originated from careful observations of the relational world of children, especially with their parents, while taking into account the interaction between genetic and environmental factors [18–21]. According to Bowlby [19], attachment styles are formed from lived experiences, particularly the childhood experiences within one's family. He defined an "attachment bond" specifically related to the trusted relationship with an attachment figure, most commonly the mother, which is seen as a "safe haven" and "secure base" in times of need [18,19]. It is now believed that early attachment style, developed through bonds of mutual affection with the caregiver, becomes integrated into the child's interpersonal style and serves as a basis for all future emotional ties. These internalized representations of social bonds, also called "working models," lead to behavioral strategies used in close relationships. The activation of the attachment system under various threats leads to involvement of healthy or unhealthy coping strategies through attachment behaviors that are meant to re-establish a sense of safety.

While combining insights from multiple schools of thought, Bowlby and Ainsworth's attachment theory has proven eminently testable and highly useful for scientific and therapeutic purposes [9], leading to the development of numerous attachment measures [22]. For instance, Ainsworth et al. [21] developed the strange situation procedure (SSP) which is the gold standard procedure to determine attachment style in infants aged 11–18 mo. The assessment involves observations of infant behavior in a series of separations and reunions with the caregiver and in the presence of a stranger. Based on the analysis of these interactions in the SSP, three types of childhood attachment styles were initially defined:

- **Secure:** the child manifests distress after separation from caregiver, but recovers quickly and continues to show interest in the environment. The child is easily comforted by the parent after reunion, expresses joy and is able to return to the previous exploration. This type of attachment is generally promoted by consistent caregiving.
- **Insecure-anxious** (also called anxious-ambivalent or anxious-resistant): the child has difficulty tolerating separation from caregivers, uses hyperactivation strategies (i.e., intensely emotional) to obtain proximity to the caregiver and is hard to console during separation or upon reunion. This style tends to be associated with inconsistent caregiving.
- **Insecure-avoidant:** the child emotionally disengages using deactivation strategies (i.e., emotionally inhibited, minimal reactivity) and seems unaffected by the separation or reunion. It tends to be associated with dismissive or neglectful styles of caregiving.

Building upon the work of Bowlby and Ainsworth, Hazan and Shaver [23] were the first to examine adult attachment style by exploring the ways in which adults relate in romantic relationships. Similar to children's attachment, securely attached adults have positive views of themselves and their partners and are comfortable with intimacy and independence. Anxiously attached individuals, also called insecure-ambivalent or preoccupied, have less positive views of themselves and their partners, tend to be preoccupied with fears of abandonment, and generally use hyperactivation strategies (e.g., asking for reassurance, clingy) to obtain attention and the emotional support they need. Conversely, avoidant individuals are generally uncomfortable with closeness and intimacy and tend to use compulsive self-reliance and deactivation strategies (e.g., emotional withdrawal) when faced with relationship challenges [9]. More recently, Bartholomew and Horowitz [24] described a fourth type of adult attachment (i.e., fearful avoidant or disorganized) which combines elements of the anxious and avoidant styles in an unpredictable and almost chaotic manner (Fig. 1 illustrates the four adult attachment styles). Over the last three decades, numerous instruments have been developed to assess adult attachment style. The adult attachment types are widely accepted and are assessed with various instruments using either categorical or dimensional approaches. For a review of attachment measures, see Ravitz and colleagues [22].

### Attachment and sleep across the lifespan

The attachment system is generally regarded as an inborn regulatory system with important implications for personality and social behavior, which is shaped primarily through interactions with the caregiver early in infancy [9]. By 6–8 mo, an infant's behavior shows the emergence of a "clear-cut" attachment style [25]. Studies have shown a moderate degree of stability in attachment style from infancy to adulthood and moderate to high stability throughout the adult years [9]. Still, while attachment styles tend to be relatively stable from childhood to adulthood, a certain degree of change can occur in response to new experiences. The stability of attachment style is due to the tendency to use pre-existing beliefs and expectations to interpret interactions in a close relationship. In addition, individuals tend to behave in ways that conform to their existing attachment style, which in turn reinforces their existing models [9]. However, cognitive models are open to revision in response to new experiences that challenge the validity of one's model [9]. For instance, a positive marriage, healthier relationships, or a skilled therapist can play a healing role in correcting maladaptive beliefs related to one's attachment

		Model of Self (Anxiety)	
		Positive (Low)	Negative (High)
Model of Other (Avoidance)	Positive (Low)	<b>Secure</b> Comfortable with intimacy and autonomy.	<b>Preoccupied</b> Preoccupied with relationships.
	Negative (High)	<b>Dismissive</b> Dismissing of intimacy. Counter- dependent.	<b>Fearful</b> Fearful of intimacy. Socially avoidant.

Fig. 1. Model of adult attachment styles based on Bartholomew and Horowitz [24].

resulting from previous traumatic interpersonal interactions. Evidence from several longitudinal studies have shown that positive and negative life events can lead to some changes in attachment security between childhood and adulthood [26–30]. However, the degree of change can vary depending on the individual due to the subjective interpretation of the interpersonal event and the individual's coping strategies [31,32]. Understanding human attachment and its stability or plasticity over time might therefore be relevant when estimating its chronic impact on health in general and sleep in particular [33].

Sleep consists of two different alternating physiological states: rapid eye movement (REM) and non-rapid eye movement (NREM) [34] which differ in a number of physiological variables (for a review, see Moszczynski and Murray [34]). REM sleep, also called paradoxical sleep in animal and neonatal sleep research, is associated with high levels of neuronal activity and is the phase of sleep more commonly associated with vivid dreams [35]. Apart from REM sleep's early role in neuronal development and learning and memory consolidation [36], it has been suggested that REM sleep may mediate attachment processes and sexual/reproductive strategies [37]. The hypothesis is based on evidence from animal and human studies which shows that REM is associated with the activation of the amygdala, which serves an important role in the appraisal of environmental cues related to survival, including attachment and reproduction. In addition, REM has also been associated with nursing behaviors in neonates and with the release of attachment promoting hormones such as prolactin and oxytocin. REM sleep was found to increase in the infant when co-sleeping with the mother and to decrease following separation. For a review of the research on REM and attachment, see McNamara and colleagues [37]. On the other hand, NREM sleep, which is characterized by three distinct stages representing a gradation in depth of sleep and decrease of arousal response [38], seems to play a role in immune function and regulation [35]. Similar to attachment development, sleep patterns are regulated within a relationship with a caregiver and undergo major changes in infancy and early childhood through a complex interplay between circadian, homeostatic and environmental factors [39]. Quantitative and qualitative sleep changes occur in response to these interactions and reflect a gradual and inevitable maturation process of neurological underpinnings.

Since the maturation of sleep regulation and attachment systems overlap developmentally during infancy and early childhood, their interaction and reciprocal influence has been questioned [15]. For instance, early in life sleep–wake regulation relies primarily on the maturation of biological networks, and is also modulated by psychosocial factors including infant–mother attachment [40]. Furthermore, emerging evidence suggests that fetal functions have circadian rhythms synchronized to maternal rest–activity cycles [41,42]. Specifically, the maternal presence during sleep, as seen in co-sleeping studies, leads to increased synchronicity between the mother and baby's sleep, enhances the mother's sensitivity to the baby's awakenings, promotes light stages of sleep for the infant, and enhances feeding [43,44]. These findings have prompted anthropological discussions on the dyadic nature of sleep as an evolutionary model meant to protect vulnerable offspring [43,44]. For instance, the synergistic nature of co-sleeping between baby and mother has been theorized to have a regulatory role in the maturation of infant sleep architecture and subsequent protection against the most common cause of infant death, sudden infant death syndrome (SIDS) [43,44]. The health benefits of early maternal presence are further supported by recent findings which showed that skin-to-skin contact between mother and premature infants during the first two weeks of life is followed by increased physiological regulation and enhanced cognitive and executive

abilities and that these benefits are maintained up to 10 y later [45]. Several studies in adults have also examined the dyadic context of sleep by investigating the impact of the quality of close relationships on various aspects of sleep. Findings have shown beneficial effects of the relationship with a partner on compliance with healthy behaviors and treatments targeting sleep disorders [46,47]. Moreover, poor marital quality has been linked to insomnia in several studies [48–52].

To conclude, attachment theory has become one of the most influential frameworks for understanding enduring patterns of relating in close relationships and has been suggested as a particularly relevant paradigm in the context of sleep research across the life span [52]. Our review provides a comprehensive presentation of the published studies to date targeting the relationship between attachment style and sleep across all ages.

## Review methods

A computerized search in PubMed was done to identify relevant peer-reviewed journal articles using the keyword search: attachment AND (sleep OR sleep quality OR sleep disorder OR dream). The search included all articles published between 1966 and October 2013 and identified 418 potential articles. The inclusion criteria was comprised of journal articles published in English with full text available, studies of human subjects of any age, general population or clinical samples, and the use of measurements of attachment style and sleep. We excluded theoretical papers and studies assessing the association between sleep and relationship variables other than attachment. Additional studies on the relationship between attachment style and sleep were also identified from the reference lists of relevant articles.

## Results

Based on our inclusion and exclusion criteria, 30 articles were identified and included in the review. One article included the results of two related studies [53]. Table 1 summarizes the study design, participant characteristics, attachment and sleep measures, and findings in all of the studies examining the relationship between sleep and attachment in all ages. The findings are discussed and organized according to four age groups: studies in infancy (<2 y), childhood (ages 2–18 y), adults (ages 18–64 y) and elderly (study age range >65 y). The overview of the studies concludes with their methodological limitations.

### *Studies in infancy (<2 y)*

To date, ten studies have examined the relationship between sleep measures, and attachment style in infancy [28,54–62]. Eight have examined healthy infants [28,54,56,58–62] and two targeted infants with sleep disorders [55,57]. See Table 1 for additional details for each study. Two longitudinal studies examined the relationship between night waking patterns at 6 mo, based on parental reports only, and attachment style assessed with SSP at age 12 mo [54] and at age 15 mo [56]. Night waking patterns were also assessed at 12 mo and at 15 mo in each respective study. Both studies found that attachment style was associated with night waking patterns at 6 mo. Infants that were classified as insecure-resistant, or insecure-anxious, woke the most at 6 mo of age, whereas insecure-avoidant infants woke the least. However, the two studies reported contrasting findings with respect to the relationship between sleep and attachment after 12 mo of age. For instance, Beijers and colleagues' [54] study did not find a significant association between attachment style and night waking at 12 mo; however, McNamara and colleagues [56] found that insecure-

**Table 1**

Studies in infants, children, adults, and elderly populations which examine the association between sleep and attachment measures.

Author	Study design	Participants	Attachment	Sleep	Other measures	Main findings
<b>Studies in infants</b>						
Beijer et al., 2011 [54]	Longitudinal: sleep assessed during 1st 6 mo & at 12 mo, attachment assessed at 12 mo	193 healthy infants (47.2% females)	SSP	Sleep diary (parent reported)	Infant temperament, maternal depression, sensitivity, cooperation, co-sleeping, breastfeeding, infant sex, maternal education level, # of siblings	Insecure-resistant infants had more night wakings during first 6 mo. Insecure-avoidant infants had lowest number of night wakings.
Benoit et al., 1992 [55]	Cross-sectional	20 toddlers with sleep disorders (45% male), 21 matched controls (57% male). Mean age cases 33 mo, controls 29.9 mo	Adult attachment interview (mother's attachment)	Cases with diagnosed sleep disorders and matched controls	Maternal self-esteem, relationship with partner, perception of social support	100% mothers of toddlers with sleep problems were insecurely attached (dismissing 65% and preoccupied 35%); 57% of controls's mothers were insecurely attached (dismissing 48%, preoccupied 9%)
McNamara et al., 2003 [56]	Longitudinal: sleep assessed at 6 & 15 mo, attachment assessed at 15 mo	342 infants (55.6% males)	SSP	Maternal reports on sleep	—	Insecure-resistant infants were more likely to wake at 6 mo and had longer night wakings at 15 mo compared with insecure-avoidant infants.
Morrell & Steele 2003 [57]	Longitudinal: sleep and attachment assessed at baseline (14–16 mo), 1 y follow-up on sleep	40 infants with sleep problems, 60 without sleep problems aged 14–16 mo	SSP	Infant sleep questionnaire, sleep diary, follow up for additional sleep problems	Family social factors, infant measures, maternal cognitive & affective, interactive bedtime behavior	Higher rate of ambivalent attachment in cases compared to controls. Ambivalent attachment was independently predictive of persistence of sleep problems a year later
Sagi et al., 1994 [63]	Cross-sectional	23 in kibbutz communal sleeping arrangement, 25 in home-based sleeping arrangements. Mean age 18.29 mo (14–22 mo)	SSP	Kibbutz communal sleeping arrangement versus home-based sleeping arrangement	Quality of daily care, mother–infant interaction, life events, infant characteristics, maternal separation anxiety, home environment	More than half of infants in communal sleeping arrangement were insecure-ambivalent while only a fifth of home-based infants were insecure-ambivalent. No infants were classified as insecure-avoidant in either group.
Scher & Asher 2004 [59]	Cross-sectional	57 healthy Israeli infants, age range 8–12 mo	Attachment Q-set (security and dependency scores; mother-reported)	Actigraphy, sleep diary, and sleep questionnaire	—	Attachment security was positively associated with sleep efficiency and negatively associated with poor sleep quality
Scher 2001 [58]	Cross-sectional	94 infants aged 12 mo	SSP	Sleep questionnaire, actigraphy on subgroup of 37 infants	Infant characteristics questionnaire	55% of the secure and 60% of the ambivalent children were described as night wakers 6% of the insecure infants, 43% of dependent-secure and 23% of secure infants had difficulty settling.
Schwichtenberg et al., 2013 [60]	Longitudinal: parenting and sleep assessed at 4 and 9 mo, attachment at 16 mo	171 preterm infants (47% female)	SSP; quality of observed parenting interactions (coded with Parent Child Early Relational Assessment)	Sleep log of daytime and nighttime sleep	Infant prematurity, family sociodemographics	Increased daytime sleep (# of naps and length) predicted secure attachment. Nighttime sleep patterns did not predict attachment. Parenting behavior predicted attachment. More socioeconomic risks predicted less daytime sleep and less optimal parenting behaviors.
Simard et al., 2013 [61]	Longitudinal: attachment assessed at 18 mo, sleep assessed at 2 y	55 children (25 girls, 30 boys)	SSP (used scores of attachment behaviors rather than categories of attachment)	Actigraphy for 72-hr period and sleep diary	—	Higher resistance during the SSP at 18 mo predicted longer wake duration at night, as perceived by mothers (diary). However, attachment behaviors were not associated with child sleep quality measured objectively (actigraphy)
Teti et al., 2010 [62]	Cross-sectional	45 infants (23 girls) divided into 5 cohorts of 1 mo, 3 mo, 6 mo, 12 mo, and 24 mo	Maternal emotional availability during bedtime activity (videotaped)	Sleep practices questionnaire, infant sleep questionnaire, sleep diary, videotaping of bedtime activity	—	Infants whose mothers were more emotionally available experienced less disruption during night and had fewer disruptions when settling.
<b>Studies in children</b>						
El-Sheikh et al., 2007 [64]	Cross-sectional	166 grade 3 elementary school children, mean age 8.72 y	Inventory of parent and peer attachment (child reported measures of mother-child attachment)	Actigraphy, child reported sleep habits survey	Child reported emotional security in marital relationship (Security in the Interparental Subsystem Scales)	Children's insecurity with the marital relationship associated with greater child-reported sleep problems

Keller et al., 2008 [65]	Cross-sectional	124 grade 3 elementary school children	Inventory of parent and peer attachment (child reported)	Actigraphy, sleep logs, child reported sleep habits survey	–	No significant relationship between attachment and self-reported sleep problems or actigraphic measures
Keller & El-Sheikh 2011 [66]	Longitudinal: sleep and attachment assessed in third grade (T1) and in 5th grade (T2)	176 children (78 boys, 98 girls) at T1, mean age 8.68 y; 142 children (62 boys, 80 girls) at T2, mean age 10.70 y	Inventory of Parent and Peer Attachment (Child-reported measures of mother-child & father-child attachment)	School sleep habits survey and actigraphy	Child reported emotional security in relation to marital relationship (Security in the Inter-parental Subsystem Scales)	Mother-child security (T1) predicted decreased sleepiness (T2). In boys, sleep activity and greater sleep efficiency (T1) predicted decreased mother-child security. Emotional insecurity about marital relationship (T1) was associated with increased sleepiness and sleep/wake problems (T2). In girls, emotional insecurity about marital relationship (T1) predicted increased sleep latency (T2) and father-child security (T1) predicted longer sleep duration (T2)
Troxel et al., 2013 [67]	Longitudinal: emotionality assessed at 6 mo, attachment at 24 mo, sleep at 24 & 36 mo, behavioral problems at 54 mo	776 children (383 boys and 393 girls)	Attachment Q-Sort (based on observed child–mother interactions)	Parent-reported child behavior checklist for sleep	Negative emotionality, teacher-reported child behavior checklist for behavior problems, sociodemographics	There was significant relationship between attachment security and sleep problems and between sleep problems and subsequent emotional/behavior problems in children with negative emotionality.
Vaughn et al., 2011 [68]	Cross-sectional	39 preschool children (12 girls, 27 boys); 20 children aged 23–48 mo, 19 children age greater than 48 mo	Attachment Story Completion (child-reported)	Actigraphy, sleep diary (parent reported)	Sickness, use of medications	Attachment security was positively associated with sleep efficiency and negatively associated with poor sleep quality.
<b>Studies in adults</b>						
Carmichael & Reis 2005 [70]	Cross-sectional	156 adults (78 married couples); mean age males 39.3 y, females 37.2 y	ECR	PSQI	Depressed affect (Center for Epidemiological Studies – Depression)	Attachment anxiety associated with poorer sleep quality. No association between attachment avoidance and sleep when depressed affect was controlled. Women reported worse sleep than men. No cross-partner affects.
Diamond et al., 2008 [71]	Cross-sectional	42 cohabitating couples; mean age 30 y (range 21–53)	ECR	PSQI	Traveling/homebound partner; positive/negative affect and events; physical symptoms; subjective stress; contact with partner and positive/negative interactions; salivary cortisol	Both partners reported greater sleeping problems during separation. Attachment anxiety increased sleeping problems in homebound partner during separation.
Escolas et al., 2013 [72]	Cross-sectional	561 post-deployed military personnel (71.8% males); aged 18 and over	RQ (categorical); ECR-R (continuous)	Measures of activity level and rhythmicity of sleep from Dimensions of Temperament Survey Revised (self-report)	–	Attachment categories associated with sleep activity level but not with rhythmicity of sleep. Secure had lowest sleep activity levels (i.e., better sleep), followed by dismissing, fearful, and preoccupied attachment styles.
Hsiao et al., 2013 [78]	Longitudinal: measures assessed at baseline, second month, fifth month, eighth month, 14th month follow-up	76 women who completed breast cancer treatment; mean age 50.8 y	ECR-R	Medical outcomes study-sleep scale	BDI-II, meaning in life, salivary cortisol, BMI, cancer, treatment.	Depressive symptoms correlated with sleep problems and attachment anxiety and avoidance. Sleep problems were positively associated with attachment anxiety and avoidance.
Maunder et al., 2011 [73]	Cross-sectional	131 female health care workers; mean age 45 y [25–63]	ECR-R	PSQI	Physical symptoms, general perceived health, sick days, depressive symptoms	Attachment anxiety and avoidance associated with poor sleep quality. Attachment anxiety associated with depressive symptoms, physical symptoms and sick days. Attachment avoidance associated with physical symptoms.
McNamara et al., 2001 (Study 1) [53]	Cross-sectional	100 undergraduate students (60% female) mean age 19	Bell's object relations and reality testing inventory	Dream recall, length, dream, content, emotional intensity, sleep disturbances	–	Insecure individuals were more likely to recall dreams, have high emotional presences and intensity, express morbid emotional content and report sleep disturbances.
McNamara et al., 2011 [79]	Cross-sectional	64 adults; age range 18–50	Half used AQ, other half used RSQ (measures are comparable but did not explain why both were used)	PSG, PSQI, sleep diary on dream recall and content	–	Individuals with avoidant attachment had poorer self-reported sleep quality than secure. Individuals with anxious attachment had reduced REM sleep latency, higher percentage of aggression in dreams, and greater self-negativity dream content.
Mikulincer et al., 2011 [7]	Cross-sectional		ECR	Dream diary for 31 d, interpersonal dreams	Daily events that made participants angry, anxious, or sad	A higher frequency of avoidance-related wishes and lower frequency of positive views of others in

(continued on next page)



Table 1 (continued)

Author	Study design	Participants	Attachment	Sleep	Other measures	Main findings
		68 university students (38 women, 30 men); mean age 24 (range 19–35)		assessed using Core Conflictual Relationship Themes		dreams associated with higher attachment avoidance. A higher frequency of proximity-closeness wishes, negative view of self and positive views of others in dreams associated with higher attachment anxiety. Distressing events during the day increased the frequency of proximity-closeness wishes and negative views of others in dreams among those with higher attachment anxiety.
Scharfe & Eldredge 2001 [74]	Cross-sectional	203 university students; mean age 19.8 y (range 17–39)	Combination of RQ and RSQ scores, current relationship status	PSQI	Health promotion and health risk score	Attachment security was associated with good quality sleep. The effect was stronger for individuals in committed relationships. Fearful and preoccupied attachment was associated with poorer sleep for those not in relationship.
Seltermann & Drigotas 2009 [82]	Cross-sectional	44 undergraduate students in romantic relationship (32 women, 12 men); mean age 19.6 (range 17–22)	Adult Attachment Questionnaire	Dream diary for 7 d; assessed dreams with romantic partners	Depression Anxiety Stress Scale	Attachment anxiety and avoidance were associated with more stress, conflict, and anxiety in dreams. Attachment avoidance was associated with negative emotions in dreams.
Seltermann et al., 2012 [81]	Cross-sectional	61 undergraduate students in committed 6+ month relationship (47 women, 14 men); mean age 20.8 (range 17–42)	Secure base script narrative assessment (relationship-specific attachment)	Dream diary for 14 d, assessed dreams about romantic partner	—	A high degree of attachment security in current relationship associated with dream content reflective of that security.
Sloan et al., 2007 [75]	Cross-sectional	31 sleep clinic patients (25 female, 6 male); mean age 41.6 (range 25–60)	ECR-R	PSG	Symptoms of anxiety and depression with symptom check list-90-R	Attachment anxiety was associated with $\alpha$ -EEG anomaly. No association between attachment avoidance and $\alpha$ -EEG or between attachment and symptoms of anxiety/depression.
Troxel & Germain 2011 [77]	Cross-sectional	49 military veterans with PTSD (85% male) mean age 41.4 y	ECR-R	PSG, PSQI	—	Attachment anxiety associated with lower percentage of stage 3–4 sleep, greater NREM beta activity. Attachment avoidance was positively associated with delta activity during NREM and REM sleep. Attachment scores were not associated with subjective sleep, sleep efficiency, duration, percentage of REM sleep, or REM delta power.
Troxel et al., 2007 [76]	Cross-sectional	107 clinically depressed women; mean age 38.4 y	RQ	PSG; PSQI	—	No association between attachment and PSQI score. High attachment anxiety had lower percentage of stage 3–4 sleep, particularly if women had been previously married.
<b>Studies in elderly</b>						
McNamara et al., 2001 (Study 2) [53]	Cross-sectional	76 community dwelling elderly participants; mean age 68.7 y (range 50–82)	RSQ	Dream recall	Health index, neuropsychological measures	Preoccupied individuals were more likely to report a dream and use greater number of words to describe dream content.
Niko Verdecias et al., 2009 [83]	Cross-sectional	70 older adults; 73% women; age range 60–85 y	RSQ	PSQI	Physical health (comprehensive assessment and referral evaluation), geriatric depression scale	No significant relationship between sleep measures and attachment style though there were noted trends: individuals with high security had little difficulty with sleep; preoccupied individuals had more daytime napping, use of sleep-induced medication and slept less during the night.

Abbreviations: AQ = attachment questionnaire; BDI-II = Beck depression inventory – II; BMI = body mass index; ECR = experiences in close relationships; ECR-R = experiences in close relationships – revised; EEG = electroencephalogram; PSG = polysomnography; PSQI = Pittsburgh sleep quality index; RSQ = relationship scales questionnaire; RQ = relationship questionnaire; SSP = strange situation procedure.

resistant infants had more and longer night wakings than insecure-avoidant infants at 15 mo, although, to a lesser degree than at 6 mo of age. In another longitudinal study, Morrell and Steele [57] further confirmed that ambivalent (i.e., insecure-anxious or insecure-resistant) attachment in 12-mo-olds was associated with sleeping problems (i.e., night waking, difficulty settling, use of parental bed) and was independently predictive of persistent sleep problems in a one-year follow-up. Taken together, these three studies suggest that insecure-anxious attachment in infants is associated with sleep problems, defined as night wakings, between 6 mo and 2 y of age.

Three studies combined parental reports of children's sleep with actigraphy, although the assessment method for attachment style differed (refer to Table 1) [58,59,61]. Overall, the studies found an association between attachment styles and parental reports of sleep problems which was similar to previous findings. Scher [58] found a marginal association between attachment style and night wakings among 1 y old infants ( $n = 94$ ) with 55% of secure children experiencing night wakings compared to 60% of ambivalent children. Interestingly, the same author showed an unexpected association between attachment and difficulty settling. Only 6% of insecure infants had difficulty settling at bed time in contrast with 43% of dependent-secure and 23% of secure infants. Scher and Asher [59] used the Attachment Q-Set, which includes a security and a dependency scale, to determine the infant–mother attachment in 8–12 mo olds ( $n = 57$ ). They found that maternal reports of sleep problems were associated with infant dependency scores while longer night wakings were associated with lower attachment security [59]. An additional study used SSP to assess infants' attachment behaviors (i.e., proximity seeking, contact maintenance, avoidance, and resistance), rather than attachment style, in 18 mo olds with a 24 mo follow-up. An association was found between resistant behaviors and longer wake duration based on parental reports of the infant's sleep [61]. Nevertheless, the three studies noted differences between parental reports and actigraphic measures of the infants' sleep patterns. Unlike the parental reports, there were no associations between the actigraphic measures (i.e., sleep duration, wake duration, number of night wakings) and attachment styles in the infants [58,59,61]. Scher's [58] study found that parental reports tended to underestimate the frequency of awakenings. However, Simard and colleagues' [61] findings suggest that specific attachment behaviors, in particular resistant behaviors in which the child responds negatively to a parent's interaction, provide an explanation for the discrepancy between subjective and objective measures. In other words, the parent's perception of the child's sleep is influenced by the behaviors which are characteristic of the infant's attachment style. Children who use resistant attachment strategies are perceived to be poorer sleepers by their mother [61]. This finding is consistent with previous studies which found insecure-resistant attachment to be associated with longer night waking [54,56,57]. Since actigraphic measurements of sleep do not provide any indication of the sleep architecture, none of the above studies provide relevant information regarding this aspect of the infants' sleep.

Four infant studies examined the influence of caregiving behavior on attachment style and sleeping patterns in infants [55,60,62,63]. Sagi and colleagues [63] compared attachment styles in infants raised in a home-based sleeping arrangement ( $n = 25$ ) to infants raised in a communal arrangement ( $n = 23$ ) with rotating caregivers. Insecure attachment styles were present in higher rates in the communal sleeping arrangement (>50%) than the home-based arrangement (20%). In a longitudinal study, Schwichtenberg and colleagues [60] examined parental reports of their pre-term infants' sleep patterns and observed parenting quality at 4 and 9 mo as predictors of their babies' attachment style at 16 mo. Innovatively, the authors included daytime and nighttime sleep

patterns in their analysis based on the assumption that pre-term infants benefit from daytime naps to “reorganize and maintain their engagement in the social environment” [60]. Although nighttime sleep patterns were not associated with attachment style, the authors found that pre-term infants with more and longer naps during the day were more likely to be securely attached. According to this study, it appears that for pre-term infants, daytime sleep was particularly important for the social and emotional development of the infant. Furthermore, Teti and colleagues [62] found that infants whose mothers were more emotionally available or attentive at bedtime, experienced less sleep disruption during the night and had fewer disruptions when settling into bed. The association was stronger in younger infants. A related study found that all of the mothers of toddlers with sleep problems ( $n = 20$ ) were insecurely attached while only 57% of mothers of the controls ( $n = 21$ ) were insecure [55]. Overall, the findings of these studies are consistent with attachment theory and suggest a direct influence of the mother–child bond on the child's attachment and sleep. For instance, immediacy of the primary caregiver as seen in the home-based sleeping arrangements [64] as well as positive parenting behaviors, as measured by the increased sensitivity to the sleep needs of infants during the day [60] or emotional availability at bed time [62] were associated with attachment security and improved sleep in infants. These findings also reveal possible intergenerational transmission of attachment insecurity as previously suggested by Bowlby [18]. Specifically, the attachment style of the parent may be reflected in their parenting behaviors which further influence the child's developing attachment style and sleep related behaviours or needs.

#### *Studies in children (ages 2–18 y)*

Five studies have examined the relationship between attachment and sleep in healthy children under the age of 11 y old [64–68]. To our knowledge, no studies to date have investigated the relationship between attachment and sleep in children/adolescents aged 12–18 y old. Two studies had a longitudinal design [66,67] while three were cross-sectional [64,65,68]. Four of the five studies used a mixture of objective (i.e., actigraphy) and subjective (i.e., child, school, and parental reported) sleep assessment. Attachment style was assessed by child inventories (children's perception of their attachment with their parents) in three studies [64–66], a narrative approach of story completion by the child in one study [68], and through behaviour observations and coding in the fifth study [67].

In an extensive longitudinal study, Troxel and colleagues [67] examined the association between negative emotionality at age 6 mo, attachment security at age 24 mo, parental reports of sleep complaints at 24 and 36 mo, and teacher-reported behavioral problems at 54 mo. Among children who were rated high in negative emotionality in infancy, there were stronger associations between attachment and sleep in toddlerhood and between sleep problems and subsequent emotional and behavioral problems at 54 mo [67]. This study suggests an interaction between biological and environmental factors in which inborn temperamental traits (i.e., negative emotionality) affect and are further affected by child rearing practices (i.e., eliciting less sensitive parenting in response to negative emotionality) and further result in a biological sensitivity to the interpersonal context as suggested by Belsky and colleagues [69]. Vaughn and colleagues [68] examined pre-school children, an age when children must switch from an *ad libitum* schedule (sleeping whenever one is tired) to a socialized sleep schedule. Unlike the previous infant studies, they found a significant association between secure attachment and actigraphic measures of sleep (e.g., sleep activity, wake time, sleep efficiency). The

association was stronger with indicators of sleep quality rather than with sleep quantity.

In a series of three related articles, Keller, El-Sheikh and colleagues examined the association between subjective and actigraphic measures of children's sleep, attachment to parents, and emotional security about the parents' marital relationship among elementary school children [64–66]. In a cross-sectional analysis of third grade children, the authors found no significant relationship between child–parent attachment and sleep [65]. However, a child's emotional insecurity regarding parents' marital relationship was associated with poorer child-reported sleep quality [64]. In a two-year follow-up, mother–child attachment security was predictive of decreased subjective sleepiness during the day for both boys and girls. Among boys, increased actigraphic sleep activity (i.e., indicative of poorer sleep) in third grade predicted a decrease of mother–child attachment security in fifth grade. Additionally, a boy's emotional insecurity about his parent's marital relationship in third grade was associated with increased sleepiness and sleep/wake problems (i.e., oversleeping, staying up late at night, falling asleep at unscheduled times) in fifth grade. Among girls, emotional insecurity about the marital relationship in third grade predicted increased actigraphic sleep latency in fifth grade while father–child attachment security in third grade predicted greater sleep duration in fifth grade [66].

With the exception of one study [65], the studies in children showed similar associations between attachment style and sleep. Lower attachment security in children was associated with poorer subjective and objective sleep measures. The association between attachment and the actigraphic sleep measures in children is a notable finding considering the infant studies which found no association between an infant's attachment and actigraphic measures of sleep. Also, findings from the two longitudinal children studies showed that attachment security predicts sleep patterns and sleep impairments predict lower attachment security. These results suggest a possible bidirectional relationship over time between parental attachment, emotional security, and sleep in children [66,67].

#### *Studies in adults (ages 18–64 y)*

Our search found 14 studies investigating the relationship between sleep and attachment style in adults [53,70–82]. Of these, only one study had a longitudinal design [78]. Five of the studies included participants from the general population [70–74], while four studies included clinical populations [75–78]. All of the non-clinical studies used self-reported sleep measures (i.e., Pittsburgh sleep quality index (PSQI)) exclusively, while three of the four clinical studies used objective sleep measures. Five studies focused on the relationship between attachment and dreams and are discussed in a separate section [53,79–82].

The non-clinical study populations included couples [70,71], university students [74], health-care workers [73], and military personnel [72]. The two studies involving couples examined the relationship between attachment and sleep within the individual and between the partners [70,71]. Carmichael and Reis' [70] study found that married individuals with anxious attachment reported poorer sleep quality compared to avoidant and secure attachment styles even when depressed affect was controlled for. They found no association between one's attachment style and the partner's sleep. In contrast, Diamond and colleagues [71] examined the relationship between attachment and sleep during periods of travel-related separation between the couples. During the separation, both partners reported sleep problems which followed a linear day-to-day decrease upon reunion, which is suggestive of an adjustment period following the separation. However, homebound

partners with high attachment anxiety experienced greater sleeping problems during separation and a greater decline in sleep problems upon reunion. Similar findings were also evident in the traveling partner when the homebound partner had high anxiety, suggesting a cross-partner effect of attachment style on sleep. The contrasting findings regarding cross-partner effects between Carmichael and Reis' [70] and Diamond and colleagues' [71] studies may be due to the social context in which they were measured. For instance, during periods of separation due to travel, the attachment-threat represented by partner's absence may have activated attachment behaviours and beliefs consistent with attachment insecurity. In turn, this insecurity may have been sensed by or discussed with the partner. In contrast, Carmichael and Reis' [70] study examined the cross-partner effect during regular days when the couples' routine was unchallenged, and therefore, consistent with a shared sense of routine and safety. In their study of 203 university students, Scharfe and Eldredge [74] included relationship status as a variable. Their findings suggested that attachment security was associated with better sleep quality while fearfulness (i.e., disorganized attachment) and preoccupied attachment (i.e., anxious) were associated with poorer sleep quality for those in committed relationships. A dismissing attachment style (i.e., avoidant) predicted poorer sleep for those not in a relationship. Unlike the previous two studies, they did not examine the role of the partner's attachment style on sleep quality.

Two non-clinical studies included populations that are at high risk for sleep disturbances: health care workers [73] and military service members [72]. Among the health care workers, both attachment anxiety and avoidance were associated with impaired sleep quality while attachment anxiety was associated with poor perceived general health and number of sick days [73]. Escolas and colleagues [72] examined the association between self-reported sleep quality, (i.e., measured by levels of activity during sleep as well as rhythmicity or regularity in sleep activities), and both categorical and continuous measures of attachment style among post-deployment military members. Categories of attachment were associated with activity level during sleep which was indicative of sleep quality. Individuals with secure attachment had the lowest levels of sleep activity (i.e., better sleep), followed by dismissing (i.e., avoidant), fearful (i.e., disorganized), and preoccupied (i.e., anxious) attachment. Overall, all non-clinical adult studies suggest that individuals with secure attachment report better sleep quality while individuals with insecure attachment (anxious in particular) report poorer sleep quality which is consistent with the infant and children studies.

Four studies examined sleep measures among adult clinical populations which included military veterans with post-traumatic stress disorder (PTSD) [77], women with clinical depression [76], a clinical sample of sleep patients [75], and breast cancer survivors [78]. Three studies included polysomnography (PSG) sleep measures [75–77]. Among the military veterans with PTSD, higher levels of attachment anxiety were associated with lower percentages of stage 3 and 4 sleep (i.e., restorative sleep) and with greater NREM beta activity. In contrast avoidant attachment was positively associated with greater delta activity during NREM and REM sleep [77]. The study showed that attachment anxiety and avoidance were independently linked with distinct differences in sleep architecture. Troxel and colleagues [76] found no significant association between attachment style and subjective sleep measures among clinically depressed women. However, while the depressive symptoms were unrelated to the objective sleep measures, women with high attachment anxiety had lower percentages of stage 3 and 4 sleep, particularly if the woman had been previously married. Sloan and colleagues' [75] study examined the relationship



between attachment and alpha-electroencephalogram ( $\alpha$ -EEG) anomaly in 31 sleep patients. The  $\alpha$ -EEG anomaly represents the occurrence of alpha waves (common during wakefulness) superimposed on low voltage waves (common during sleep) which indicates abnormal levels of arousal during sleep. The  $\alpha$ -EEG class was significantly associated with attachment anxiety but not with avoidance. The study also found no association between attachment and concurrent symptoms of depression and anxiety. A longitudinal study by Hsiao and colleagues [78] examined the relationship between self-reported sleep problems, attachment style, meaning in life, salivary cortisol, and depressive symptoms in women with breast cancer at the post-treatment stage. Even though it was not the primary focus of the study, the findings showed that sleep problems were positively associated with attachment anxiety and avoidance.

In summary, majority of adult studies investigating both clinical and non-clinical populations suggest a relationship between attachment and sleep, independent of the presence of depression or anxiety. Moreover, insecure attachment, and in particular anxious attachment, seems to be associated with poorer sleep based on subjective reports as well as differences in sleep architecture.

#### *Studies in the elderly (>65 y)*

Two studies included participants over the age of 65 y of age [53,83]. One of the studies, however, focused on the relationship between attachment and dreams and is discussed in the next section [53]. Niko Verdecias and colleagues [83] examined the relationship between self-reported sleep quality, attachment, physical health, and symptoms of depression. While the results lacked the statistical power to fully assess the relationships between attachment and all of the sleep measures, the authors noted several trends in the data which were consistent with previously reported findings in other age groups. Individuals with high attachment security reported better sleep while preoccupied individuals were more likely to report daytime napping, use of sleep-inducing medication, and a tendency to sleep less at night. It was unclear, however, if the differences in napping were due to distress or were a residual effect of sleep medication.

#### *Attachment and dreams across the lifespan*

Five adult studies examined the relationship between attachment and dreams [53,79–82]. This research was based on the hypothesis that dream recall and dream content may be reflective of interpersonal attachment styles, given the overlap between the anatomy and physiology of REM and attachment system in humans [16,17]. In keeping with the line of research which suggests that REM sleep promotes bonding, the authors explored if dream reporting (e.g., frequency) or dream content would reflect bonding themes [16]. McNamara and colleagues [53] examined the association between attachment and dream recall and dream content among two populations: 100 undergraduate students whose attachment was dimensionally assessed (e.g., high versus low insecurity) and 76 community dwelling elderly adults, whose attachment was categorically classified. Among the students, they assessed the association between the level of attachment insecurity and dream characteristics (i.e., recall, frequency, length, content, emotional intensity) as well as sleep disturbances (i.e., sleep walking, nightmares, tooth grinding). Insecure individuals were more likely to recall a dream, report high emotional occurrence and intensity related to its content, and report sleep disturbances when compared with individuals with low levels of insecure attachment. Yet, there was no difference in attachment related dream content

between subjects with high or low attachment anxiety [53]. The study examining elderly population studied dream recall and content as well as other measures such as health index and neuropsychological measures that can affect dream recall. Preoccupied individuals were more likely to report a dream and use a greater number of words to describe it compared to securely attached or avoidant individuals. Dream recall was not associated with health, depression, anxiety or stress. In a follow-up study on dreams and attachment, McNamara and colleagues [79] included PSG and self-reported sleep measures (PSQI). Anxiously attached individuals had reduced REM sleep latency when compared with secure individuals, as well as higher aggression/friendliness and self-negative dream content after REM awakening, when compared with avoidant ones. Based on the subjective sleep measures, avoidant individuals had poorer sleep compared to secure individuals. In contrast with the previous study by McNamara (2001), there were no significant differences in dream recall rates across the attachment groups.

Three more studies focused on the relationship between attachment and interpersonal content of dreams [80–82]. In two related studies, Selterman and colleagues [81,82] examined the dream content of romantic partners in relation to attachment style among undergraduate students. In the first study, Selterman and Drigotas [82] found that students with anxious or avoidant attachment experienced significantly more stress and conflict in their dreams compared with students with secure attachment, and that attachment anxiety correlated with observed jealousy in dreams experienced by individuals under personal distress. The second study focused on the dreams of securely attached students and found that participants with high degrees of attachment security in their current relationship had dreams of their partner that reflected their security [81]. Similarly, Mikulincer and colleagues [80] analyzed the content of interpersonal dreams in association with attachment anxiety and avoidance among a group of university students who had high dream recall (i.e., at least three dreams per week). The narratives of interpersonal dreams were reflective of the attachment-related working models of the self and others as well as the hyperactivation and deactivation strategies associated with attachment anxiety and attachment avoidance, respectively. Individuals with high levels of avoidance had a higher frequency of avoidance-related wishes and a lower frequency of positive representations of others in their dreams. The dreams of those with high anxiety had a higher frequency of proximity and closeness wishes, negative representations of self, and positive representations of others. Among those with higher attachment anxiety, distressing events that made the participants angry, anxious or sad during the day increased the frequency of proximity and closeness wishes in dreams and resulted in negative representations of others. There was no effect found among those with higher avoidance, which is reflective of the emotional activation strategies associated with the attachment styles. Those with attachment anxiety tend to use hyperactivation, or intensely emotional strategies, while those with attachment avoidance use deactivation strategies which are emotionally inhibited.

To summarize, the studies investigating the relationship between attachment and dreams show positive associations in several domains related to frequency of dream recall and the emotional dream content particularly among individuals with anxious attachment. However, the inconsistent findings and marked variation between the quantitative and qualitative coding of the dream content across studies makes overall interpretation difficult. Moreover, the theoretical leap suggesting that dream content is directly suggestive of the physiological role played by REM sleep in promoting attachment remains debatable.

### Methodological limitations of the studies

The first methodological issue in interpreting the existing literature is the fact that the majority of studies (22 out of 30) were cross-sectional which precludes inferences concerning causation. For instance, the children, adult and elderly studies, with only three exceptions, were cross-sectional. Fortunately, the infant studies were a mix of longitudinal (five studies) and cross-sectional (five studies). However, difficulties in interpreting the longitudinal infant studies come from the limitations associated with assessing attachment style at a very young age. While sleep patterns can be assessed at a very early age, SSP, the standard way to determine attachment style in infants, is not applicable until 11 mo due to the temporal development of attachment. While three of the five longitudinal infant studies assessed sleep in infants younger than 1 y of age (e.g., 6–9 mo) [54,56,60], attachment was only assessed after 12 mo. Although, two of the studies showed an association between sleeping patterns at 6 mo and attachment style assessed at 12 mo [54,56], the sensitivity of the SSP represents a methodological challenge. Specifically, an infant's behavior can show signs of their developing attachment style at 6–8 mo [25]. In order to clarify a possible causal relationship between the child's attachment style and sleep, it may be necessary to develop and validate other methods to assess relevant behaviours pertaining to developing attachment at an earlier age. This approach might shed light on the relationship between parental attachment and infant's developing attachment and sleep. For example, one of the longitudinal studies assessed the quality of the parental interaction, which influences a child's developing attachment style, at 4 and 9 mo, in addition to assessing attachment style at 16 mo [60].

In addition to the limitations in measuring attachment at a very young age, the infant and children studies lacked insight into differences in sleep architecture. Overnight in-lab polysomnography (PSG) is the gold standard for the diagnosis of a number of sleep disorders and provides a snapshot of an individual's sleep architecture. Unfortunately, PSG in infants and children are challenging to perform in the home environment and therefore a variety of alternative measures were used (e.g., actigraphy, parental reports). Conversely, while some of the adult studies used PSG, it is worth noting that the method has limited utility in assessing the impact of normal sleep architecture on a number of physiological daytime variables, since it does not assess circadian rhythm or chronic sleep patterns. Actigraphy was the objective sleep measurement used in the majority of infant and children studies. While providing a simple non-invasive objective measurement of total sleep time, actigraphy provides no information on sleep architecture. Moreover, Simard and colleagues [61] showed that various actigraphy algorithms produced different results which raises questions about the validity of the results and makes interpretation difficult. Still, despite their complementarity in assessing various aspects of sleep, no studies have considered including both actigraphy and PSG. The interpretation of subjective sleep measures in children also proves challenging, given that it is performed by parents. It has been suggested that parental reports tend to underestimate sleep difficulties such as sleep latency and number of awakenings [58,59]. Additionally, there may be fundamental differences in the way that parental and other measures are interpreted. As Scher and Asher [59, p. 298] point out, the definition of a sleep problem based on self-reports, or parental reports in the case of young children, and those measured objectively are likely to target different constructs. For example, Simard et al. [61] suggest that the parent's perception of sleep, rather than sleep quality, measured objectively, differs based on a child's attachment style. It may be that self- or parent-reported sleep quality is influenced by behaviors and coping strategies inherent to the specific attachment styles. Also, the parents'

own attachment styles may influence their perception of the child's sleep and partly reflect their own behavioral responses to their child's sleeping needs.

The difficulty in evaluating the literature with adult and elderly populations comes from the lack of longitudinal data, and a predominance of subjective assessments of sleep. Overnight PSG, the gold standard, was used in only four adult studies which were predominately clinical populations. Nineteen of the studies had small samples sizes ( $n < 100$ ), including the two clinical studies ( $n < 50$ ), which limits the generalizability of findings. It should also be noted that the degree of variability and changeability of attachment style in response to environment cannot be excluded given the cross-sectional data. As previously mentioned, attachment displays both trait and state components, with the latter being more sensitive to environmental influences. Therefore, levels of attachment insecurity in adults can also reflect the quality of the current relationship and its stability. As a result, when assessing the relationship between attachment and sleep in adults, it is also important to consider the quality of the current interpersonal relationship in which attachment is measured as well as general levels of anxiety, depression and life satisfaction that can further impact sleep.

### Discussion

The study's main purpose is to present a systematic review of human studies examining the link between individual attachment style and sleep across the lifespan. Taken together, the data suggests a relationship between attachment style and sleep that starts early in life and persists over the years. Individuals with insecure-anxious attachment, (i.e., also called preoccupied in adult studies or ambivalent/resistant in children studies), seem to be particularly at risk for poorer sleep quality [54,56,57,61,70–72]. Some studies indicate that individuals with insecure-avoidant attachment may be less prone to sleep disruptions [54,70], while other studies have noted an impact on dream content or physical symptoms [73,79,80]. Although several theoretical models have been proposed and partly supported by evidence (for a review, see Keller [15]), there is no clear understanding on how sleep and attachment systems interact and influence each other over the life span. A few cross-sectional and longitudinal studies in infants and children support a bidirectional influence where attachment style and sleep difficulties influence one another [54,56,57,60,61,66,67]. However, subjective sleep measures and developmental limitations in assessing attachment at an early age make interpretation difficult. Furthermore, the lack of longitudinal studies in adults or the elderly precludes inferences regarding the direction of influence between sleep and attachment systems or the mechanisms involved in their interaction across the lifespan. While far from being conclusive, the emerging evidence suggests that a bidirectional influence between attachment and sleep starts early in life and continues throughout life. In addition, it appears that various aspects of this complex interaction are prone to vary in relevance according to developmental stage. This view is also supported by complementary research investigating the bidirectional connection between sleep and the quality of relationships in couples [52,84]. For instance, Hasler and Troxel [84] found that, in males, poor sleep predicted more negative ratings of partner interactions the next day which suggest that sleep disruptions can influence one's capacity to manage interpersonal communication. Interestingly, a stronger relationship for reverse association was found in females where daytime interaction affected nighttime sleep. Similarly, Yang and colleagues [85] found a bidirectional relationship between sleep and relationship quality. Poor marital quality was a risk factor for sleep disturbance for older adults, while sleep disturbances seemed

to lead to lower marital quality for all age groups. As a result, a variety of factors need to be taken into account when exploring the relationship between attachment style and sleep. These factors may be age specific and serve a developmentally-suitable and adaptive role. For instance, while studies in infants and children take into account individual sleep needs, temperament and parental behaviors [54,60,62], adult and elderly studies need to consider marital status, sleeping partner characteristics, and comorbidity with anxiety and depression [74,76,84]. Examining gender differences in all ages may also show gender specific vulnerabilities [66,76].

In line with our findings, several methodological aspects need to be further considered. First, using gold standard attachment measures (e.g., SSP, adult attachment interview (AAI)) while also evaluating the quality of close relationships may elucidate the interpersonal context of the attachment style. Second, when assessing sleep, combining subjective and objective sleep measures with good validity and different emphases (e.g., actigraphy, PSG) can also distinguish between various aspects of sleep that can distinctly affect or be affected by attachment style. Third, designing studies with larger samples sizes that are representative of both the general and clinical populations can be relevant for further innovative interventions targeting attachment, sleep, or both.

With respect to the psychological and physiological mechanisms involved in the interaction between attachment and sleep, many empirical questions remain. Insights from human studies as well as animal studies suggest that threats to the attachment bond exist through separation impact sleep quality and quantity [16,86–90]. For instance, a few studies have shown a significant disruption or reduction in REM sleep as well as increases in sleep latency and REM latency as measured by EEG, after a separation from the mother in young animals [86,91,92] or a close partner in adult humans [93,94]. Other studies have shown an alteration in physiological processes following maternal-infant separation, such as persistent alteration of respiratory control during sleep [95]. A review by McNamara [37] concluded that the evidence from recent animal studies on sleep and separation seem to have a selective effect on REM, but not on slow-wave sleep. However, while these studies seem to point to a link between attachment and sleep physiology, some authors have questioned the psychological dimension of the attachment bond in animal models and focused instead on physiological regulation. Specifically, the mother's role in meeting the baby's needs for food and warmth is identified as a major stabilizer in the sleep–wake cycle. In addition, there are suggestions that REM suppression early in life may lead to adverse long-term consequences during adulthood. For instance, the administration of REM-suppressant medications in neonatal rats has been shown to produce depressive symptoms and sexual dysfunction in the rats as they reach maturity [37]. As mentioned earlier, in humans, it has been hypothesized that REM sleep mediates attachment processes early in life and later sexual/reproductive strategies [37]. This line of thinking is supported by Pearleman's [96] review of human studies which showed a psychological impact of REM deprivation on interpersonal relationships. Interestingly, our review found no human studies in infants or children exploring the relationship between attachment style and REM. Only one adult study found a relationship between attachment anxiety and reduced REM sleep latency [79]; while two additional studies showed an association between attachment anxiety and NREM sleep suppression [76,77].

In summary, sleep and attachment represent complex systems whose maturation overlaps temporally, and whose interaction appears to persist throughout life. Since both sleep and attachment have a significant impact on the quality of life including physical and mental health and vulnerability to future illness,

understanding this relationship is likely to have direct clinical benefits. Additional research with refined methodology, longitudinal design, and representative samples of the general population as well as various clinical populations are needed. This research is likely to contribute to the development of sensitive diagnostic tools for sleep disorders and related psychological difficulties by taking into account the interaction between psycho-social and biological aspects of each individual. Ultimately, understanding the relationship and direction of influence between attachment and sleep across the lifespan and their amenability to various interventions will inform important, innovative, and more holistic approaches of treating and preventing sleep disorders in insecure individuals.

### Practice points

- The majority of the studies reviewed suggest a relationship between attachment style and sleep difficulties in all ages. Secure attachment is associated with better sleep quality while insecure attachment styles are linked with poorer sleep.
- Studies in infants and children suggest a reciprocal influence between sleep and attachment.
- Most adult and elderly studies had a cross-sectional design making it difficult to draw conclusions about the predictive power of attachment with respect to sleep difficulties and vice versa.
- Studies in clinical populations are significantly under-represented with only four such studies in adults (e.g., PTSD, depression, breast cancer survivors).
- While individual factors need to be taken into account (e.g., age, sex, marital status, concurrent diagnosis, etc.), individual attachment style may be a clinically relevant measure when addressing sleep difficulties.
- An individual's dream content might be indicative of attachment style.

### Research agenda

Future research into the relationship between attachment style and sleep should:

- Design longitudinal studies assessing sleep and attachment in all ages in order to better define the direction of influence.
- Use attachment instruments with strong psychometric properties that target various aspects of sleep (i.e., subject-rated and partner or parent-rated sleep scales, actigraphy, and PSG) in order to identify the specific aspects of sleep that are influenced by attachment.
- Explore the relationship between attachment style and dream content in children.
- Explore the relationship between attachment and sleep in clinical populations.
- Target larger sample sizes that are representative of the general population
- Clarify the impact on sleep of various challenges to attachment security (e.g., series of separations and reunions between sleep partners).
- Explore therapeutic interventions on the relationship between attachment and sleep. For instance, measuring the effect of attachment oriented therapies on sleep or the impact of sleep management (i.e., medication, behavioral therapy, etc.) on relationship quality and attachment style.



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